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DIAGNOSING AND CORRECTING INDIVIDUAL DEFICIENCIES IN LEARNING MUSIC. FINAL REPORT.

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THERE IS A DICHOTOMY WHICH EXISTS IN EDUCATION AND--IN PARTICULAR, IN THE DOMAIN OF MUSIC LEARNING--IN THE ASSUMPTION THAT INDIVIDUAL DIFFERENCES IN LEARNING ARE MET IN A LARGE GROUP-INSTRUCTION PROGRAM. THE MAIN OBJECTIVE IN THE RESEARCH WAS TO TEST AND TO EVALUATE A CLINICAL TYPE OF INSTRUCTIONAL PROGRAM BASED ON INDIVIDUAL DIFFERENCES IN SUCH A MANNER THAT DIAGNOSES COULD BE MADE AND INDIVIDUAL'S MUSIC AILMENTS COULD BE TREATED IN LEARNING THREE BASIC MUSIC ELEMENTS. PHASE I WAS AN ITEM ANALYSIS OF STUDENT WORKSHEETS AND TEST PAPERS ACCUMULATED FROM USING AUTO-INSTRUCTIONAL METHODS IN PAST RESEARCH. PHASE II WAS A DISCRIMINATIVE ANALYSIS SO THAT PREDICTIONS COULD BE MADE FOR THE SELECTIVE AUTO-INSTRUCTIONAL TREATMENT OF INDIVIDUALS. PHASE III WAS AN EXPERIMENT USING THOSE FRESHMEN MUSIC STUDENTS WHO WERE ENROLLED IN THE FUNDAMENTALS OF MUSIC COURSE AT THE OHIO STATE UNIVERSITY IN THE ACADEMIC YEAR 1966-67. FROM THE RESEARCH IT WAS POSSIBLE TO DISTINGUISH INDIVIDUALS AND GROUPS AS A PARTICULAR TYPE OF LEARNING PROBLEM, WHICH COULD BE DEALT WITH ON AN INDIVIDUAL-GROUP BASIS, WITH THE PREDICTED GAIN SCORES ESTABLISHED. (AUTHOR)

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MARCH, 1968

U. S. Department of
Health, Education, and Welfare

Office of Education
Bureau of Research

The Ohio State University
Research Foundation
Columbus, Ohio 43212

Final Report
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March 31, 1968

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Office of Education
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INTRODUCTION

Historically, educational and psychological research studies investigating classroom instruction have been oriented toward group research. There has been a tradition of group research established which includes such variables as class size and homogeneous groupings. New research has been directed toward the development of new taxonimies of learning as well as new technologies in the field of education. Similarly, testing programs have been designed to measure certain learned skills, capacity for learning, and/or acquired knowledge of the individual. These testing data when reported emphasize group characteristics. Instruction and techniques involving various media have been researched and evaluated, the data reported either show no significant difference or show the gains for group learning achieved by new procedures to be higher than achievements made by students in a traditional classroom approach. Group presentations of these new approaches have been standardized, and despite a reported significant improvement or no significant difference in learning, the variance reported in the learning among students would be expected to be as great as the variance in learning which exists in the traditional classroom.

Individual differences exist as a large source of variance in reported data. To date, there seems to be no research which has found a single method that is universally successful and meets the needs of individual differences. A contextual research program at The Ohio State University for the past three years has investigated the differential effects of twenty-seven auto-instructional methods. During this time the accumulated data and experiences of students observed indicate a next step in research was needed to meet the challenge of learning. The next step was to use existing data and researched auto-instructional methods in a different manner. Even though the researched auto-instructional methods have improved learning, there was no evidence to support the position of a single best method. There was evidence to suggest the possibility that measurable individual differences were important in _the learning_ or _not learning_ of an individual by a particular method. It appeared, therefore, that a new kind of strategy was needed to attack the problem of improved learning for all. Individual differences which could be measured could be utilized. Educational ills must be individually diagnosed. A spectrum of relevant research-proven differential treatments must be available.

Even though much has been said about meeting individual differences in education, little attempt has been made to use measurable individual differences to provide tailored instructional programs to meet the individual needs.

There is a need to develop a diagnostic testing and instructional program which incorporates differential treatments that are geared to the individual differences of students and will give these students a predicted assurance of optimal learning. Since present teachers have neither these kinds of data or instruments, the testing-instructional programs must be ones which can be codified and are economically and generally feasible.

RELATED RESEARCH

Although there has been considerable research undertaken to explore human learning, there is little evidence in the research literature that any attempts have been made to pair individual differences to achievement in learning except after the fact. The recognition of individual differences has been reported when these differences exist only as a source of variance in a statistical analysis of research data. To date no teaching machine and/or program for learning appears to be adequate for meeting the needs of all students (Coulson and Silberman, 1961), (Campbell, 1963). There is some indication (Krumboltz, 1964) that even the difference in effective learning brought about with a verbal program in which some students made a required response and other students were not required to make a response might be due to individual differences.

For ten years, an organized program of research in music learning has been in progress at The Ohio State University. Spohn (1959) reported an experiment in music learning in which a self-presentation technique was used. Information was presented aurally on magnetic tape and students wrote their responses. When the experimental group's achievement was compared with the achievement of a control group using traditional instruction, the experiment group showed a significant improvement in their learning of the material. A refinement of this technique, based on a paired-associate procedure, was reported (Spohn, 1962) using different subject matter for learning. Again the data showed significant improvement in the groups' learning.

In both studies, however, even though all students made improvement some students did not achieve optimal learning. In an attempt to research this problem further, the learning of three basic music elements using four different methods was investigated (cf. Film made pursuant to a contract with the U. S. Office of Education, "Self-Teaching of Music Fundamentals", The Ohio State University MCMLXIV, Charles L. Spohn). Spohn and Poland (1964) reported the differential effects of aural or visual presentation of learning basic music materials when students used either written or voice responses. Spohn (1965) reported that the students, even though trained differently, showed a great amount of transfer to like tasks. In each of the experiments the kind of response which students made was statistically significant to their learning; however, the manner in which information was presented was not significant. An additional finding (Spohn and Poland, 1964) was that the background factors which included various aspects of specific music training, as well as general education, have significant influences upon the students' learned behavior. The individual differences (other factors) were significant in each experiment.

A further extension of this research was continued (Spohn, 1965c). The first phase of the research investigated the differential effects of six additional auto-instructional methods for learning each of three basic music elements. Spohn (1964) reported group gains from one of these experiments. The data indicated one method out of six is superior for learning a basic music element by some students, while not as effective for others. On the other hand, group gains in all instances improved. Once again, however, it is observed that individual differences (other factors) did, in fact affect individual outcomes. The data from the continued research (Spohn, 1965c) gave further support to the earlier findings.

An extensive testing program has been developed and used over a period of ten years (Poland, 1960) for the selective admission of students to the music curricula at The Ohio State University. Some of the refinements and use of this testing program for the research program at The Ohio State University are reported in <u>An Evaluation of Two Methods Using Magnetic Tape Recordings for Programed Instruction in the Elemental Materials of Music</u> (Spohn and Poland, 1964, pp. 27-37). The test data to date have been used primarily as an instrument for the selective admission of students into the music curricula. In addition, it has been a routine procedure to use these tests in all relevant investigations because their use forms a common statistical reference base.

OBJECTIVES

The main objective in the research was to test and evaluate a clinical type of instructional program for diagnosing and treating individual basic music ailments. This main objective can be broken down into three specific objectives:

1.- to determine from a further analysis of data from past research sponsored by the U. S. Office of Education (which evaluated only differential effects of twenty-seven auto-instructional methods) individual student error patterns and work scores and classify these by method and individual characteristics;

2.- to establish a system for diagnosing students' basic music learning ailments and predicted from an existing spectrum of differential auto-instructional methods the needed treatment for a given set of individual characteristics;

3.- to undertake an experiment with a group of students so that an evaluation of this clinical type of instructional program can be made.

METHOD

There has been a large quantity of data accumulated from both the testing program and the auto-instructional research program which goes beyond the original intent of either. It was believed, therefore, that the test data[1] and the data from the immediate past three years' auto-instructional research program in music[2] could be used to provide the basis for the selective educational treatment of individuals to learn music.

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[1]Background information and test data include: American College Test, Music Skill and Information, General Music Information, Music Recognition, Basic Elements of Music Test, Pretest and Posttest for Basic Music Skills, Age, Sex, Applied Music Performance Area, and Applied Music Audition Grade (cf. Spohn and Poland, 1964, p. 36; and Spohn 1963c, pp. 24, 69 and 104).

[2]Student worksheets and tests from OE Grant Number 7-34-0430-172, An Evaluation of Two Methods Using Magnetic Tape Recordings for Programed Instruction in the Elemental Materials of Music and OE Grant Number 7-45-0430-214, A Comparison Between Different Stimuli Combined with Two Methods for Providing Knowlege of Results in Music Instruction.

Procedure. The work plan for the research was carried out in three phases.

Phase I

1.- Phase I was an item analysis of student worksheets and test papers accumulated from past research[3], which investigated the differential effects in learning three basic music elements by using nine auto-instructional methods (cf. Figure 1). This is a total of twenty-seven methods.

Figure 1

Basic Music Element	Music Auto-Instructional Treatment								
	1	2	3	4	5	6	7	8	9
A Rhythm									
B Interval									
C Tone Group									

2.- Code and develop a scoring procedure from the item analysis which will result in a total workscore for each student which could be used in an existing statistical program and could be used in the prediction portion of this study.

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[3] Approximately 450 students had been through the instructional program. These data were a large source of information. Item analyses (even though considered raw data) of these kinds of materials provide information about individual errors and learning patterns that were not available through more sophisticated statistical analyses. Howe-ever, even coding and scoring did not make their use in statistical analysis possible.

Phase II

1.- Phase II was a discrimination analysis, using data from the past three years' research (cf. footnote number 1) and work-scores from the item analysis, step 2, Phase I, to predict and thereby to provide for the selective educational auto-instructional treatment of individuals to learn three basic music elements by means of the existing spectrum of auto-instructional methods shown in Figure 1. In Figure 2, it is possible to observe the various relationships between the categorization of individual characteristics, basic music elements, and auto-instructional treatments. An illustration of this procedure might be as follows (cf. Figure 2):

Figure 2

	Classification of Individual Characteristics								
	1	2	3	4	5	6	7	8	9
Basic Music Elements	AUTO-INSTRUCTIONAL TREATMENTS								
	I	II	III	IV	V	VI	VII	VIII	IX
A Rhythm									
B Interval									
C Tone Group									

A general individual characteristic classification might be one in which those girls who have had private piano instruction (cell 1) show the most improvement in learning the basic music element, rhythm (cell A) using auto-instructional method I, which incorporates an aural presentation-written-response and visual knowledge of results. This provides the basis for Phase III.

Phase III

Phase III was a three-part experiment. The sample used in this study consisted of those Freshmen who were enrolled in the fundamentals of music course at The Ohio State University in the academic year 1966-67 (approximately 130 students).

These students, upon entry to the fundamentals of music class in the autumn of 1966, were given tests[3] (Spohn and Poland, 1964) referred to in Phase II, number 1.

On the basis of the data obtained from Phases I, II, and the test data, Phase III, students' music educational malady was diagnosed and these students were assigned the appropriate predicted auto-instructional treatment(s) to achieve optimum learning, Figure 2. It should be noted, however, that the possibility existed that all cells shown in Figure 2 would not be used. This, of course, depended upon the outcome of the analyses. (cf. Film made pursuant to a contract with the U.S. Office of Education, "Self-Teaching of Music Fundamentals", The Ohio State University MCMLXIV, Charles L. Spohn, for an example of some of the auto-instructional methods.)

RESULTS AND FINDINGS

In each of three quarters, a group of approximately 130 students was divided into three groups, each of which was given a particular type of music training (cf. Appendix B). In each quarter each student was tested on the three aspects of the training, even though he was subjected to only one of them. Both the training groups and the tests are designated A, B, C. In summary:

Groups or tests	Autumn-Rhythm	Winter-Intervals	Spring-Tone Groups
A	Single tone	Ascending	Ascending
B	Series	Descending	Descending
C	Taps	Harmonic	Ascending/Descending

At the beginning of each quarter, all students took the three tests A, B, C. These will be referred to as the initial tests or pretests. On the basis of these initial tests, the students were divided into three groups A, B, C. An attempt was made to balance the high, medium, and low initial scores in the three groups. In the Winter and Spring Quarter the additional criterion of splitting up the groups from the previous quarter was also invoked. It is believed that the resulting groups were as balanced on initial scores as possible.

Three tests A, B, C, were administered to all the students at the end of each quarter. The difference between the posttest and the pretest will be called the gain score. In the Autumn Quarter the maximum possible score on a test was 100. The percentage gain score in this case would be (Gain Score)/(100 - Pre-Score). For the Winter and Spring Quarters the maximum scores were 64 and 36. For those quarters the percentage gain scores were Gain/(64-pre) and Gain/(36-pre), respectively.

Tables I-V give the means, standard deviations and correlations for the Initial Scores, the Gain Scores and the Percentage Gain Scores. Note that for Autumn the scores are also divided into Duple, Tripe and Duple-Triple combined.

Table I

Means, Standard Deviations and Correlations for the Initial Scores, the Gain Scores, and Percentage Gain Scores for Autumn Duple Rhythm Only

Group	n	Means A 42	Means B 46	Means C 43	Means Total 131	Standard Deviations A	Standard Deviations B	Standard Deviations C	Standard Deviations Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
Initial Test	A	15.619	14.000	14.163	14.573	15.329	12.931	11.916	13.357	A-B	.93	.92	.91	.92
	B	20.571	20.000	20.953	20.491	18.213	16.484	17.942	17.402	A-C	.88	.88	.88	.87
	C	24.810	23.413	25.256	24.466	18.912	17.134	18.495	18.044	B-C	.97	.97	.95	.96
Gain	A	36.000	33.348	36.488	35.229	13.826	13.020	13.943	13.555	A-B	.90	.69	.81	.79
	B	29.619	31.935	30.349	30.672	14.872	13.647	16.070	14.785	A-C	.76	.67	.72	.71
	C	28.095	28.065	28.791	28.313	14.459	13.531	16.660	14.802	B-C	.88	.90	.89	.89
Gain / 64-pre	A	.779	.692	.749	.738	.214	.235	.237	.230	A-B	.68	.77	.90	.74
	B	.696	.748	.727	.725	.281	.191	.243	.239	A-C	.68	.71	.81	.74
	C	.754	.711	.751	.738	.249	.216	.273	.245	B-C	.76	.49	.83	.78

Table II

Means, Standard Deviations and Correlations for the Initial Scores, the Gain Scores, and Percentage Gain Scores for Atumn Triple Rhythm Only

Group	n	Means A 42	Means B 46	Means C 43	Means Total 131	Standard Deviation A	Standard Deviation B	Standard Deviation C	Standard Deviation Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
Initial Test	A	11.405	11.000	10.651	11.015	15.329	7.780	8.150	7.890	A-B	.90	.88	.91	.89
	B	15.405	12.957	13.674	13.977	18.213	8.246	9.536	8.999	A-C	.82	.86	.85	.84
	C	18.167	15.522	17.558	17.038	18.912	9.993	10.496	10.160	B-C	.93	.91	.94	.92
Gain	A	15.905	13.674	15.279	14.916	6.450	6.318	8.113	7.008	A-B	.62	.65	.63	.59
	B	11.960	14.674	12.293	13.165	6.501	6.360	7.504	6.859	A-C	.46	.62	.67	.57
	C	11.143	13.457	11.465	12.061	7.380	8.123	9.305	8.311	B-C	.73	.81	.83	.80
<u>Gain</u> 36-pre	A	.694	.559	.631	.626	.250	.229	.283	.258	A-B	.62	.65	.63	.59
	B	.601	.666	.585	.619	.276	.225	.360	.291	A-C	.71	.51	.08	.21
	C	.680	.693	.490	.622	.272	.259	.931	.579	B-C	.53	.74	.22	.32

Table III

Means, Standard Deviations and Correlations for the Initial Scores, the Gain Scores, and Percentage Gain Scores for Autumn Duple and Triple Rhythm Combined

Group		Means A	Means B	Means C	Means Total	Standard Deviation A	Standard Deviation B	Standard Deviation C	Standard Deviation Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
	n	42	46	43	131									
Initial Test	A	27.024	25.000	24.814	25.588	22.398	19.613	18.141	19.967	A-B	.95	.94	.95	.94
	B	35.976	32.957	34.628	34.473	26.428	23.253	25.332	24.826	A-C	.91	.91	.90	.90
	C	42.976	38.935	42.814	27.791	25.726	25.726	26.124	26.397	B-C	.98	.97	.95	.97
Gain	A	51.905	47.022	51.767	50.145	19.059	17.204	19.601	18.614	A-B	.89	.74	.84	.80
	B	41.310	46.609	43.279	43.817	19.929	17.791	20.980	19.542	A-C	.76	.69	.72	.71
	C	39.238	41.522	40.256	20.374	20.017	19.347	22.149	20.379	B-C	.87	.93	.89	.89
Gain / 100-pre	A	.750	.648	.711	.702	.219	.209	.233	.223	A-B	.81	.80	.87	.79
	B	.685	.721	.685	.698	.244	.185	.234	.221	A-C	.82	.71	.75	.75
	C	.738	.710	.716	.721	.224	.215	.271	.236	B-C	.77	.85	.86	.82

Table IV

Means, Standard Deviations and Correlations for the Initial Scores, the Gain Scores, and Percentage Gain Scores for Winter Interval

Group		Means A	Means B	Means C	Means Total	Standard Deviations A	Standard Deviations B	Standard Deviations C	Standard Deviations Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
	n	43	37	32	112									
Initial Test	A	11.116	10.000	10.500	10.571	6.123	6.110	6.263	6.121	A-B	.84	.87	.90	.86
	B	9.233	9.243	9.813	9.402	6.252	6.130	6.591	6.259	A-C	.66	.79	.85	.75
	C	5.837	6.027	7.031	6.241	4.928	6.296	5.949	5.673	B-C	.76	.89	.88	.84
Gain	A	8.000	5.649	4.531	6.232	3.988	3.882	4.204	4.243	A-B	.44	.49	.53	.45
	B	4.814	5.838	4.094	4.946	4.090	3.395	3.514	3.741	A-C	-.32	.40	.47	.13
	C	2.651	2.757	4.188	3.125	3.301	3.662	4.734	3.898	B-C	-.02	.34	.37	.18
Gain / 24-pre	A	.668	.470	.256	.485	.259	.304	.512	.396	A-B	.06	.71	.45	.30
	B	.291	.480	.294	.354	.375	.306	.274	.335	A-C	.08	.68	.33	.29
	C	.177	.217	.262	.215	.247	.301	.464	.337	B-C	-.01	.66	.17	.22

Table V

Means, Standard Deviations and Correlations for the Initial Scores, the Gain Scores and Percentage Gain Scores for Spring Tone Groups

Group	n	Means A 39	Means B 35	Means C 29	Means Total 101	Standard Deviations A	Standard Deviations B	Standard Deviations C	Standard Deviations Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
Initial Test	A	11.538	12.000	12.222	11.881	9.703	10.102	10.382	9.929	A-B	.94	.96	.92	.93
	B	12.538	11.943	13.074	12.475	11.914	10.849	11.069	11.226	A-C	.82	.94	.81	.85
	C	7.436	6.971	8.037	7.436	10.550	9.460	8.825	9.651	B-C	.87	.91	.78	.86
Gain	A	8.436	7.000	5.333	7.109	7.130	5.641	4.772	6.132	A-B	.50	.64	.58	.52
	B	3.872	8.143	3.481	5.248	5.850	8.012	7.138	7.252	A-C	.39	.25	.40	.31
	C	4.462	3.029	6.333	4.465	6.832	3.937	7.835	6.374	B-C	.30	.03	.21	.12
Gain / 48-pre	A	.281	.227	.204	.241	.263	.195	.232	.233	A-B	.33	.68	.57	.45
	B	.094	.253	.111	.154	.286	.242	.312	.286	A-C	.43	.60	.60	.49
	C	.125	.087	.178	.126	.236	.131	.235	.206	B-C	-.15	.33	.30	.06

Preliminary Analysis

The first question to be raised regards the relevancy of the music scores, MSI, GI, MR. To answer this an analysis of variance on the groups A, B, C, with the pre (or initial) score and the scores MSI, GI, MR in covariance was carried out. This was done on the Duple A, B, C, A+B+C and Triple A, B, C, A+B+C gain scores for the Autumn Quarter. Some of these results are summarized in Table VI The first F in the table tests the hypothesis that the coefficient of the pre score was always significantly different than zero. The F's (with one exception) for the variables MSI, GI, MR were generally small. It was decided at this point to ignore these measurements in subsequent analyses.

The average effect of a particular type of training, i.e., groups A, B, C on students in the Autumn Quarter on students' training in the Winter Quarter was minimized by distributing the students, say, in the Autumn A group over all three groups in the Winter Quarter. The same was done in the Spring Quarter relative to the groups in the Winter Quarter. An analysis of variance was carried out to see whether the preceding group division was important. In particular, a given student could be classified Autumn A, B, C, and Winter A, B, C and the effects of these classifications as well as their interaction was studied. Table VI contains the F's that test whether the effects of these classifications are zero on the gain scores A, B, C and A+B+C. This analysis was carried out for both Winter-Autumn and Spring-Winter. Only students that were present both quarters were used. In all cases the interaction of the two quarter classifications was not significant as well as the effect of the previous quarter classification. This result justifies -- to some extent at least -- analyzing the scores for each quarter separately.

Comparison of Group Means

Since the three tests A, B, C are correlated, the hypothesis of no differences in the training groups was tested in a multi-variate analysis of variance. For each quarter the following array exhibits the means:

Table VI

Results of Preliminary Analysis

F's for testing hypotheses that certain given variables have no effect in the regression of the gain scores on these variables.

Autumn Quarter ($n = 128$)

	Gain Score	Group A,B,C	MSI,GI,Mr
Duple	A	1.31	3.05*
	B	.30	1.34
	C	.50	2.05
	A+B+C	.21	1.54
Triple	A	1.85	.45
	B	1.22	.96
	C	.24	.76
	A+B+C	.03	.49

Winter Quarter ($n = 106$)

Gain Score	Autumn Group A,B,C	Winter Group A,B,C	Autumn and Winter Group Interaction
A	2.47	14.08**	1.20
B	1.01	2.18	.64
C	2.21	.70	1.16
A+B+C	2.00	1.93	1.32

Spring Quarter ($n = 97$)

Gain Score	Winter Group A,B,C	Spring Group A,B,C	Winter and Spring Group Interaction
A	2.00	3.48*	0.26
B	1.49	3.92*	1.53
C	.60	2.31	.36
A+B+C	2.46	.24	.63

Test	Group A	Group B	Group C
A	m_{AA}	m_{AB}	m_{AC}
B	m_{BA}	m_{BB}	m_{BC}
C	m_{CA}	m_{CB}	m_{CC}

The null hypothesis to be tested is that simultaneously

$$m_{AA} = m_{AB} = m_{AC}$$

$$m_{BA} = m_{BB} = m_{BC}$$

$$m_{CA} = m_{CB} = m_{CC}$$

For a given group the three test scores give rise to a variance-covariance matrix. As an example, refer to Table VII, Autumn, first page, the first entry 363.2590 is the sample variance for group A on the gain A score. The square root of this number is 19.059, the standard deviation found in Table I. Similarly, 397.1458, 400.6736 are the variances of the gain B and gain C scores in group A. The 338.64 is the covariance of the gain A and gain B score. The correlation of A and B could be obtained by dividing the covariance by the two associated standard deviations. Briefly, the variance-covariance matrix for a group contains information about the variability of the scores and their interdependence. Tables VII-IX contain these matrices (the lower half was not typed for convenience) for each group and for the entire group for both the gain scores and percentage gain scores. One should note that in the separate groups the variances and covariances are computed about their respective means whereas in the entire group the variances and covariances are computed about the means of the entire group. Intuitively, then, if the null hypothesis is correct, one would expect that the average (Table X) of the three group matrices would resemble the matrix for the entire group.

Table VII

Variance-Covariance Matrix for Autumn Rythm Study

Variance-Covariance Matrix for Gain Scores

Group	n	Variable A	B	C
A	42	363.2590	338.6400	290.3403
			397.1458	348.7782
				400.6736
B	46	295.9773	225.4531	230.2995
			316.5101	319.2976
				374.2995
C	43	384.1827	345.5644	311.3228
			440.1584	411.5698
				490.5759
Total	131	346.4634	291.6883	269.8915
			381.9046	355.5691
				415.3129

Variance-Covariance Matrix for Percentage Gain

$\left(\frac{\text{Gain}}{\text{100-pre}}\right)$ **Scores**

Group	n			
A	42	.047977	.043499	.040390
			.059443	.042088
				.049996
B	46	.043530	.030767	.031848
			.034347	.033998
				.046287
C	43	.054346	.047507	.047165
			.054969	.054906
				.073392
Total	131	.049559	.039029	.039455
			.048698	.042640
				.055644

Table VIII

Variance-Covariance Matrix
for Winter Interval Study

Variance-Covariance Matrix for Gain Scores

		Variable		
Group	n	A	B	C
A	43	15.9048	7.16667	4.21429
			16.7265	-0.209302
				10.8992
B	37	15.0676	6.49700	5.71772
			11.5285	4.20946
				13.4114
C	32	17.6764	7.81956	9.34879
			12.3458	6.14315
				22.4153
Total	112	17.9997	7.15669	2.09685
			13.9971	2.65541
				15.1914

Variance-Covariance Matrix for Percentage Gain

$\left(\frac{\text{Gain}}{\text{100-pre}}\right)$ Scores

A	43	.0672117	.0055595	.0053699
			.1406818	-.0012657
				.0609746
B	37	.092294	.0658843	.0618972
			.0934443	.0603733
				.0907351
C	32	.2617364	.0632183	.0787814
			.0750453	.0211080
				.2154790
Total	112	.1565632	.0400169	.0382923
			.1123472	.0252044
				.1138819

Table IX

Variance-Covariance Matrix
for Spring Tone Group Study

Variance-Covariance Matrix for Gain Scores

Group	n	Variable A	B	C
A	39	50.8313	20.8731	19.1883
			34.2200	11.9555
				46.6761
B	35	31.8235	29.0294	5.64706
			64.1849	0.966386
				15.4992
C	27	22.7692	19.6795	15.000
			50.9516	11.5256
				61.3846
Total	101	37.5980	22.9428	12.2688
			52.5881	5.5237
				40.6313

Variance-Covariance Matrix for Percentage Gain

$\left(\frac{\text{Gain}}{\text{100-pre}}\right)$ Scores

A	39	.0692633	.0247994	.0264859
			.0821998	-.0100989
				.0554653
B	35	.0380188	.0320386	.0154569
			.0588118	.0103967
				.0171959
C	27	.0536267	.0412265	.0329123
			.0970355	.0217169
				.0554281
Total	101	.0542390	.0300467	.0235349
			.0817639	.0034158
				.0426051

Table X

Composite Variance-Covariance Matrices

Quarter	Variable	n	A	B	C
Autumn	Gain (Comb)	131	347.8063	303.2198	277.3209
				384.6048	359.8819
					421.8497
	%Gain (Comb)	131	.0386173	.0304909	.0298010
				.0394862	.0436643
					.0565584
	Gain (Duple)	131	185.0301	163.0421	146.0189
				221.8804	198.0947
					223.2329
	%Gain (Duple)	131	.0523476	.0424197	.0416446
				.0581728	.0474268
					.0610623
	Gain (Triple)	131	49.11301	35.14356	34.80829
				46.63397	44.97801
					69.01397
	%Gain (Triple)	131	.0649563	.0467777	.0332100
				.0854206	.0521704
					.3361826
Winter	Gain	112	16.21625	7.16107	3.61741
				13.53359	3.38110
					15.57532
	%Gain	112	.1404158	.0448874	.0486828
				.1030571	.0267385
					.1223962
Spring	Gain	101	35.14135	23.19401	13.27844
				49.78547	8.14917
					41.18663
	%Gain	101	.0536363	.0326882	.0249517
				.0793490	.0073382
					.0426964

The likelihood ratio test of the hypothesis is based on this idea and is, indeed, determined by the ratio of the determinants of these matrices. These D_c/D_a ratios are tabulated in Table XI The exact distribution of this ratio is known and the probability associated with this ratio is also given in Table XI. In all cases the hypothesis may be rejected, i.e., differences exist among the groups on the gain scores and on the percentage gain scores.

Since Test A is over the training received in group A, Test B over that in group B, Test C over that in group C, one might expect that the means m_{AA}, m_{BB}, m_{CC} would be the largest in their respective comparisons. Except for Test C in the Autumn Quarter this was the case. This fact combined with the above test of significance would lead to the conclusion that the training was at least effective in raising the score in that particular area.

The use of the percentage gain score allows one to compare the A, B, C scores within a group. No test of significance was carried out here but one can observe that in the A group the percentage gain for the A score was the largest, in the B group the percentage gain for the B score was the largest, but that there was no consistency for the C group.

Analysis of Gain Scores as Related to Groups and Initial Scores

For each of the gain scores the effects of the classifications by groups was studied in an analysis of variance with the three initial scores in covariance. The results are given in Table We shall look at the first one as an example. The gain in A (duple + triple) is given in a multiple regression form by

$$\text{gain in A} = -1.200\ (\text{pre A}) + 0.1051\ (\text{pre B}) + 0.579\ (\text{pre C})$$

$$+ \begin{Bmatrix} 2.402 \text{ if in group A} \\ -2.252 \text{ if in group B} \\ -0.150 \text{ if in group C} \end{Bmatrix} + 53.263$$

Thus, the gain in A is greatest if the pre A score is small, the pre B, pre C scores large and one is in group A. The coefficients of the pre A and pre C scores are significantly different than zero.

Table XI

Testing Equality of Means

Quarter	Variable	D_c/D_a	Probability
Autumn	Gain-Duple	.9571	.473
	Gain-Triple	.8783	.0111
	Gain-Duple + Triple	.8906	.022
	% Gain-Duple	.9258	.134
	% Gain-Triple	.9158	.083
	% Gain-Duple + Triple	.8704	.007
Winter	Gain	.8271	.002
	% Gain	.7937	.0003
Spring	Gain	.8266	.005
	% Gain	.8755	.045

Selected Group

Quarter	Variable	D_c/D_a	Probability
Autumn	Gain Duple	.9139	.076
	Gain Triple	.9174	.090
	Gain Duple + Triple	.8664	.021
	% Gain Duple	.8033	.0001
	% Gain Triple	.8991	.035
	% Gain Duple + Triple	.7860	.0003
Winter	Gain	.7838	.003
	% Gain	.6746	.00001
Spring	Gain	.8636	.084
	% Gain	.8722	.109

In the Winter and Spring Quarters the regressions are rather consistent in that the gain in a score is greatest if the same pre score is least and if the training corresponding to that score is used. A few cases counter to that occur in the Autumn. Furthermore, the groups exhibit more significant differences in the Winter and Spring as opposed to the Autumn. The use of these regression equations as predictors will be examined, as follows.

Prediction of Gain Scores from Initial Scores and Training.

The regression equations given in Tables XII-XIV enable one to predict the mean gain score or the mean percentage gain score for an individual with known pre scores and group assignment. It must be borne in mind that the leeway (or error) involved in such a prediction is determined in great part by the standard deviation. This value is given under σ in Tables XII-XIV and it is immediately evident that the prediction of an individual's score is not very accurate. It is better to think of the prediction of the mean of a group of students rather than of an individual student.

Using the mean pre scores from Table I we shall label an individual as average (A) if his pre score is the average of the total group; we shall label him as low (L) if his pre score is one standard deviation below the mean and as high (H) if his pre score is one standard deviation above the mean. For example, in the Autumn on score A a student is A, L, or H if his initial test is 25.588, 5.621, or 45.555. Using this classification on each initial test, i.e., A, B, C we obtain 27 different "types" of individuals. For each of these types, the predicted mean for each of the three scores is given in Tables XV-XX. This has been done for each quarter and for both gain and percentage gain scores. These tables show the effects of the pre scores, effects which can also be seen directly from the regression coefficients in Tables XII-XIV. The changes from group to group are also evident from Tables XII-XIV.

The Difference between the Post and Pre Scores

The difference between the post and pre scores is the basic measurement in assessing differences among the treatment groups. The analysis of these gain scores is made more precise by taking out the effects due to initial scores in the analysis of covariance. In

Table XII

Regression Coefficients for Gain Scores on Pre Scores and Groups
Autumn Quarter

Dependent Variable	Pre A	Pre B	Pre C	Group A	Group B	Group C	Const.	σ
Duple + Triple								
Gain - A	-1.200*	0.1051	.5790*	2.402	-2.252	- .150	53.263	15.460
B	- .3168	- .9436*	.7066*	-1.592	3.073	-1.481	55.042	15.118
C	- .2451	- .03067	-.3277*	- .2508	.1200	.1308	61.297	15.112
Total	-1.532*	- .863	.736	1.109	.757	- .352	17.516	45.719
Duple A	-1.0613*	.0212	.4758*	1.657	-2.037	0.380	38.680	11.351
B	- .1370	-1.0983*	.6403*	-1.0083	1.3523	-0.3440	39.474	10.888
C	- .1196	- .0299	- .4803*	.0548	- .8566	.8018	42.438	10.541
Total	-1.316*	-1.131	.653	.569	-1.348	.779	120.654	31.574
Triple A	-1.03197*	.3893*	.23998*	.4773	- .5834	+ .1061	.2737	5.828
B	- .2080	- .5578*	.3009*	- .8769	1.4528	- .5759*	.7508	5.635
C	- .1254	.2903	-.7081*	- .4666	.6341	- .1675	.3800	6.131
Total	-1.292*	.387	-.551	- .0766	- .1912	.2678	57.552	18.700
Duple + Triple								
% Gain - A	- .004360*	.003018	.005003*	.04201	- .03959	- .00242	.50271	.1800
B	- .004555*	-.003162	.009533*	- .01487	.04160	- .02673	.52679	.1959
C	- .001906	-.001307	.005070*	.01407	- .00096	- .01311	.60427	.2290
Total	- .01083	-.00146	.01962*	.04111	.00110	- .04221	16.338	.5614
Duple								
% Gain - A	- .002874	.001133	.007238*	.03941	- .04108	.00167	.58120	.1987
B	- .005869	-.007131	.014144*	- .02551	.03215	- .00664	.59614	.2239
C	- .002607	-.0007434	.004997	- .01603	- .02384	.0077	.05997	.2439
Total	- .01135	-.00674	.02638*	.02994	- .03282	.00288	1.8601	.6152
Triple								
A	- .01369*	.01881*	.005477	.03928	- .04090	+ .00162	.42128	.2192
B	- .01475*	.0005656	.01666*	- .0300	.0753	- .0453*	.4873	.2777
C	- .02222	.02683	-.009582	.0412	.0846	- .1258*	.6535	.5759
Total	- .05066*	.04621*	.01256	.0503	.1191	- .1694*	1.562	.8359

Table XIII

Regression Coefficients for Gain Scores on Pre Scores and Groups
Winter Quarter

Dependent Variable		Pre A	Pre B	Pre C	Group A	Group B	Group C	Const.	σ
Gain	A	-.5536*	.2119*	.04388	2.322	-.658	-1.664*	9.618	3.407
	B	.1073	-.4380*	.1526	- .179	.941	- .762*	6.953	3.403
	C	.05661	.4364*	-.4394*	- .697	-.449	1.146*	1.255	3.554
Total		-.3327	.2191	-.3083	1.516	-.261	-1.255	17.610	8.225
% Gain	A	-.008929	.005163	.014990	.2162	.0056	- .2218*	.4154	.3585
	B	.000086	-.01325	.02543*	-.05472	.12937	- .07465*	.31901	.3186
	C	.004158	.021100*	-.001874	-.04099	.00420	.03679	-.01218	.3095
Total		-.00467	.01301	.03854*	.1206	.1392	- .2598*	.7221	.7199

Table XIV

Regression Coefficient for Gain Scores on Pre Scores and Groups
Spring Quarter

Dependent Variable		Pre A	Pre B	Pre C	Group A	Group B	Group C	Const.	σ
Gain	A	-.3306*	.3101*	.2116*	1.390	0.390	-1.780*	5.398	5.587
	B	.6153*	-.8588*	.4203*	-1.022	2.649	-1.627*	5.436	6.210
	C	.6339*	.2439*	-.7157*	.058	-1.855	+1.797*	-0.646	4.428
Total		.9075*	-.2983	-.0792	.388	1.207	-1.595	10.192	13.830
% Gain	A	-.001289	.010702*	.007921*	.04310	-.00011	- .04299*	.05921	.1507
	B	.02258*	-.02880*	.01633*	-.04854	.09000	- .04146*	.12212	.25113
	C	.01774*	.00791*	-.01656*	.00073	-.04837	.04764*	-.05639	.1453
Total		.03906*	-.01021	.00768	-.00468	.04151	- .03683	.12496	.4246

TABLE XV

Predictions of Gain Scores Based on Given Individual Group Pre Test Scores for Duple and Triple Rhythm

Pretest Score Group	Predicted Gain Score for Variable A			Predicted Gain Score for Variable B			Predicted Gain Score for Variable C			Total Predicted Gain Score		
	A	B	C	A	B	C	A	B	C	A	B	C
HHH	38.94	34.29	36.39	21.60	26.26	21.71	30.00	30.37	30.38	90.54	90.92	88.48
HHA	23.63	18.98	21.08	2.86	7.52	2.97	38.71	39.08	39.09	65.20	65.58	63.14
HHL	8.32	3.67	5.77	-15.88	-11.22	-15.77	47.42	47.79	47.80	39.86	40.24	37.80
HAH	36.21	31.56	33.66	44.94	49.60	45.05	30.74	31.11	31.12	111.90	112.28	109.84
HAA	20.90	16.25	18.35	26.20	30.86	26.31	39.46	39.83	39.84	86.55	86.93	80.49
HAL	5.59	0.94	3.04	7.46	12.12	7.57	48.17	48.54	48.55	61.21	61.59	59.15
HLH	33.48	28.83	30.93	68.27	72.93	68.38	31.49	31.86	31.87	133.24	133.62	131.18
HLA	18.17	13.52	15.62	49.53	54.19	49.64	40.20	40.57	40.58	107.90	108.28	105.84
HLL	2.86	-1.79	0.31	30.79	35.45	30.90	48.91	49.28	29.29	82.55	82.93	80.94
AHH	62.91	58.26	60.36	27.99	32.65	28.10	34.99	35.36	35.37	125.89	126.27	123.83
AHA	47.59	42.94	45.04	9.25	13.91	9.36	43.70	44.07	44.08	100.55	100.93	98.49
AHL	32.28	27.63	29.73	-9.49	-4.83	-9.38	52.41	2.78	52.78	75.20	75.58	73.14
AAH	60.17	55.52	57.62	51.33	55.99	51.44	35.74	56.11	36.11	147.24	147.62	145.18
AAA	44.86	40.21	42.31	32.59	37.25	32 70	44.45	44.82	44.83	121.90	122.28	119.84
AAL	29.55	24.90	27.00	13.85	18.51	13.[illegible]	53.16	53.53	53.54	96.56	96.94	94.50
ALH	57.44	52.79	54.89	74.67	79.33	74.[illegible]	36.48	36.85	36.86	168.59	168.97	166.53
ALA	42.13	37.48	39.58	55.92	60.58	56.03	45.19	45.56	45.57	143.25	143.63	141.19
ALL	26.82	22.17	24.27	37.18	41.84	37.29	53.90	54.27	54.28	117.90	118.28	115.84
LHH	86.87	82.22	84.32	34.38	39.04	34.49	39.98	40.35	40.36	161.24	161.62	159.18
LHA	71.56	66.91	69.01	15.64	20.30	15.75	48.70	49.07	49.08	135.89	136.27	133.83
LHL	56.25	51.60	53.70	-3.10	1.56	-2.99	57.41	57.78	57.79	110.55	110.93	108.49
LAH	84.14	79.49	81.59	57.72	62.38	57.83	40.73	41.10	41.11	182.59	182.97	180.53
LAA	68.83	64.18	66.28	38.98	43.64	39.09	49.44	49.81	49.82	157.25	157.63	155.19
LAL	53.51	48.86	50.96	20.24	24.90	20.35	58.15	58.52	58.53	131.90	132.28	129.84
LLH	81.41	76.76	78.86	81.06	85.72	81.17	41.47	41.84	41.85	203.94	204.32	201.88
LLA	66.10	61.45	63.55	62.31	66.97	62.42	50.18	50.55	50.56	178.59	178.97	176.53
LLL	50.78	46.13	48.23	43.57	48.23	43.68	58.90	59.27	59.28	153.25	153.63	151.19

Table XVI

Predictions of Percentage Gain Based on Given Individual Group Pretest Scores for Duple and Triple Rhythm

Pretest Score	Predicted Gain Score for Variable A			Predicted Gain Score for Variable B			Predicted Gain Score for Variable C			Total Predicted Gain Score		
Group	A	B	C	A	B	C	A	B	C	A	B	C
HHH	0.7931	0.7115	0.7487	0.6274	0.6839	0.6156	0.7311	0.7160	0.7039	2.1516	2.1114	2.0682
HHA	0.6611	0.5795	0.6167	0.3766	0.4331	0.3648	0.5965	0.5814	0.5693	1.6341	1.5939	1.5507
HHL	0.5291	0.4475	0.4847	0.1258	0.1823	0.1140	0.4618	0.4467	0.4346	1.1167	1.0765	1.0333
HAH	0.7186	0.6370	0.6742	0.7068	0.7633	0.6950	0.7634	0.7483	0.7362	2.1888	2.1486	2.1054
HAA	0.5866	0.5050	0.5422	0.4560	0.5125	0.4442	0.6288	0.6137	0.6016	1.6714	1.6312	1.5880
HAL	0.4546	0.3730	0.4102	0.2052	0.2617	0.1934	0.4941	0.4790	0.4669	1.1539	1.1137	1.0705
HLH	0.6441	0.5625	0.5997	0.7862	0.8427	0.7744	0.7957	0.7806	0.7685	2.2260	2.1858	2.1426
HLA	0.5121	0.4305	0.4677	0.5354	0.5919	0.5236	0.6610	0.6459	0.6338	1.7086	1.6684	1.6252
HLL	0.3801	0.2985	0.3357	0.2846	0.3411	0.2728	0.5264	0.5113	0.4992	1.1912	1.1510	1.1078
AHH	0.8810	0.7994	0.8366	0.7192	0.7757	0.7074	0.7691	0.7540	0.7419	2.3692	2.3290	2.2858
AHA	0.7490	0.6674	0.7046	0.4684	0.5249	0.4566	0.6344	0.6193	0.6072	1.8518	1.8116	1.7684
AHL	0.6170	0.5354	0.5726	0.2176	0.2741	0.2058	0.4998	0.4847	0.4726	1.3344	1.2942	1.2510
AAH	0.8065	0.7249	0.7621	0.7987	0.8552	0.7869	0.8013	0.7862	0.7741	2.4065	2.3663	2.3231
AAA	0.6745	0.5929	0.6301	0.5479	0.6044	0.5361	0.6667	0.6516	0.6395	1.8890	1.8488	1.8056
AAL	0.5425	0.4609	0.4981	0.2971	0.3536	0.2853	0.5321	0.5170	0.5049	1.3716	1.3314	1.2882
ALH	0.7320	0.6504	0.6876	0.8781	0.9346	0.8663	0.8336	0.8185	0.8064	2.4437	2.4035	2.3603
ALA	0.6000	0.5184	0.5556	0.6273	0.6838	0.6155	0.6990	0.6839	0.6718	1.9263	1.8861	1.8429
ALL	0.4680	0.3864	0.4236	0.3765	0.4330	0.3647	0.5643	0.5492	0.5371	1.4088	1.3686	1.3254
LHH	0.9688	0.8872	0.9244	0.8111	0.8676	0.7993	0.8070	0.7919	0.7798	2.5869	2.5467	2.5035
LHA	0.8368	0.7552	0.7924	0.5603	0.6168	0.5485	0.6724	0.6573	0.6452	2.0695	2.0293	1.9861
LHL	0.7048	0.6232	0.6604	0.3095	0.3660	0.2977	0.5377	0.5226	0.5105	1.5520	1.5118	1.4686
LAH	0.8943	0.8127	0.8499	0.8905	0.9470	0.8787	0.8393	0.8242	0.8121	2.6242	2.5840	2.5408
LAA	0.7623	0.6807	0.7179	0.6397	0.6962	0.6279	0.7046	0.6895	0.6774	2.1067	2.0665	2.0233
LAL	0.6303	0.5487	0.5859	0.3889	0.4454	0.3771	0.5700	0.5549	0.5428	1.5893	1.5491	1.5059
LLH	0.8199	0.7383	0.7755	0.9700	1.0265	0.9582	0.8715	0.8564	0.8443	2.6614	2.6212	2.5780
LLA	0.6879	0.6063	0.6435	0.7192	0.7757	0.7074	0.7369	0.7218	0.7097	2.1440	2.1038	2.0606
LLL	0.5559	0.4743	0.5115	0.4684	0.5249	0.4566	0.6023	0.5872	0.5751	1.6265	1.5863	1.5431

TABLE XVII

Predictions of Gain Scores Based on Given Individual Group Pre Test Scores for Intervals

Pretest Score Group	Predicted Gain Score for Variable A			Predicted Gain Score for Variable B			Predicted Gain Score for Variable C			Total Predicted Gain Score		
	A	B	C	A	B	C	A	B	C	A	B	C
HHH	6.45	3.47	2.47	3.52	4.64	2.94	3.22	3.47	5.07	13.19	11.58	10.48
HHA	6.22	3.24	2.24	2.67	3.79	2.09	5.71	5.96	7.56	14.60	12.99	11.89
HHL	5.99	3.01	2.01	1.82	2.94	1.24	8.21	8.46	10.06	16.02	14.41	13.31
HAH	5.13	2.15	1.15	6.27	7.39	5.69	0.47	0.72	2.32	11.87	10.26	9.16
HAA	4.91	1.93	0.93	5.42	6.54	4.84	2.96	3.21	4.81	13.29	11.68	10.58
HAL	4.68	1.70	0.70	4.57	5.69	3.99	5.45	5.70	7.30	14.71	13.10	12.00
HLH	3.82	0.84	-0.16	9.03	10.15	8.45	-2.29	-2.04	-0.44	10.56	8.95	7.85
HLA	3.59	0.61	-0.39	8.18	9.30	7.60	0.21	0.46	2.06	11.97	10.36	9.26
HLL	3.37	0.39	-0.61	7.33	8.45	6.75	2.70	2.95	4.55	13.39	11.78	10.68
AHH	9.89	6.91	5.91	2.83	3.95	2.25	2.84	3.09	4.69	15.56	13.95	12.85
AHA	9.66	6.68	5.68	1.98	3.10	1.40	5.34	5.59	7.19	16.98	15.37	14.27
AHL	9.44	6.46	5.46	1.13	2.25	0.55	7.83	8.08	9.68	18.40	16.79	15.69
AAH	8.58	5.60	4.60	5.58	6.70	5.00	0.09	0.34	1.94	14.25	12.64	11.54
AAA	8.35	5.37	4.37	4.73	5.85	4.15	2.58	2.83	4.43	15.67	14.06	12.96
AAL	8.12	5.14	4.14	3.88	5.00	3.30	5.08	5.33	6.93	17.08	15.47	14.37
ALH	7.26	4.28	3.28	8.34	9.46	7.76	-2.66	-2.41	-0.81	12.94	11.33	10.23
ALA	7.04	4.06	3.06	7.49	8.61	6.91	-0.17	0.08	1.68	14.35	12.74	11.64
ALL	6.81	3.83	2.83	6.64	7.76	6.06	2.32	2.57	4.17	15.77	14.16	13.06
LHH	13.26	10.28	9.28	2.16	3.28	1.58	2.48	2.73	4.33	17.89	16.28	15.18
LHA	13.03	10.05	9.05	1.31	2.43	0.73	4.97	5.22	6.82	19.31	17.70	16.60
LHL	12.80	9.82	8.82	0.45	1.57	-0.13	7.47	7.72	9.32	20.73	19.12	18.02
LAH	11.94	8.96	7.96	4.91	6.03	4.33	-0.28	-0.03	1.57	16.58	14.97	13.87
LAA	11.72	8.74	7.74	4.06	5.18	3.48	2.22	2.47	4.07	17.99	16.38	15.28
LAL	11.49	8.51	7.51	3.21	4.33	2.63	4.71	4.96	6.56	19.41	17.80	16.70
LLH	10.63	7.65	6.65	7.66	8.78	7.08	-3.03	-2.78	-1.18	15.26	13.65	12.55
LLA	10.40	7.42	6.42	6.81	7.93	6.23	-0.54	-0.29	1.31	16.68	15.07	13.97
LLL	10.17	7.19	6.19	5.96	7.08	5.38	1.96	2.21	3.81	18.10	16.49	15.39

TABLE XVIII

Predictions of Percentage Gain Based on Given Individual Group Pretest Scores for Interval

Pretest Score	Predicted Gain Score for Variable A			Predicted Gain Score for Variable B			Predicted Gain Score for Variable C			Total Predicted Gain Score		
Group	A	B	C	A	B	C	A	B	C	A	B	C
HHH	0.7419	0.5313	0.3039	0.3602	0.5443	0.3402	0.3253	0.3705	0.4031	1.4274	1.4461	1.0472
HHA	0.6568	0.4462	0.2188	0.2162	0.4003	0.1962	0.3361	0.3813	0.4139	1.2091	1.2278	0.8289
HHL	0.5718	0.3612	0.1338	0.0722	0.2563	0.0522	0.3468	0.3920	0.4246	0.9908	1.0095	0.6106
HAH	0.7093	0.4987	0.2713	0.4435	0.6276	0.4235	0.1932	0.2384	0.2710	1.3460	1.3647	0.9658
HAA	0.6243	0.4137	0.1863	0.2995	0.4836	0.2795	0.2040	0.2492	0.2818	1.1277	1.1464	0.7475
HAL	0.5392	0.3286	0.1012	0.1554	0.3395	0.1354	0.2147	0.2599	0.2925	0.9094	0.9281	0.5292
HLH	0.6768	0.4662	0.2388	0.5267	0.7108	0.5067	0.0611	0.1063	0.1389	1.2646	1.2833	0.8844
HLA	0.5917	0.3811	0.1537	0.3827	0.5668	0.3627	0.0719	0.1171	0.1497	1.0463	1.0650	0.6661
HLL	0.5067	0.2961	0.0687	0.2387	0.4228	0.2187	0.0827	0.1279	0.1605	0.8280	0.8467	0.4478
AHH	0.7976	0.5870	0.3596	0.3596	0.5437	0.3396	0.2990	0.3442	0.3768	1.4562	1.4749	1.0760
AHA	0.7126	0.5020	0.2746	0.2156	0.3997	0.1956	0.3098	0.3550	0.3876	1.2379	1.2566	0.85[illegible]
AHL	0.6275	0.4169	0.1895	0.0716	0.2557	0.0516	0.3205	0.3657	0.3983	1.0196	1.0383	0.6394
AAH	0.7651	0.5545	0.3271	0.4429	0.6270	0.4229	0.1669	0.2121	0.2447	1.3748	1.3935	0.9946
AAA	0.6800	0.4694	0.2420	0.2988	0.4829	0.2788	0.1777	0.2229	0.2555	1.1565	1.1752	0.7763
AAL	0.5950	0.3844	0.1570	0.1548	0.3389	0.1348	0.1885	0.2337	0.2663	0.9382	0.9569	0.5580
ALH	0.7325	0.5219	0.2945	0.5261	0.7102	0.5061	0.0348	0.0800	0.1126	1.2934	1.3121	0.9132
ALA	0.6475	0.4369	0.2095	0.3821	0.5662	0.3621	0.0456	0.0908	0.1234	1.0751	1.0938	0.6949
ALL	0.5624	0.3518	0.1244	0.2381	0.4222	0.2181	0.0564	0.1016	0.1342	0.8568	0.8755	0.4766
LHH	0.8521	0.6415	0.4141	0.3590	0.5431	0.3390	0.2733	0.3185	0.3511	1.4843	1.5030	1.1041
LHA	0.7670	0.5564	0.3290	0.2150	0.3991	0.1950	0.2841	0.3293	0.3619	1.2660	1.2847	0.8858
LHL	0.6820	0.4714	0.2440	0.0709	0.2550	0.0509	0.2948	0.3400	0.3726	1.0478	1.0665	0.6676
LAH	0.8195	0.6089	0.3815	0.4422	0.6263	0.4222	0.1412	0.1864	0.2190	1.4030	1.4217	1.0228
LAA	0.7345	0.5239	0.2965	0.2982	0.4823	0.2782	0.1520	0.1972	0.2298	1.1847	1.2034	0.8045
LAL	0.6494	0.4388	0.2114	0.1542	0.3383	0.1342	0.1627	0.2079	0.2405	0.9664	0.9851	0.5862
LLH	0.7870	0.5764	0.3490	0.5255	0.7096	0.5055	0.0091	0.0543	0.0869	1.3216	1.3403	0.9414
LLA	0.7019	0.4913	0.2639	0.3815	0.5656	0.3615	0.0199	0.0651	0.0977	1.1033	1.1220	0.7231
LLL	0.6169	0.4063	0.1789	0.2375	0.4216	0.2175	0.0307	0.0759	0.1085	0.8850	0.9037	0.5048

TABLE XIX

Predictions of Gain Scores Based on Given Individual Group Pre Test Scores for Tone Groups

Pretest Score	Predicted Gain Score for Variable A			Predicted Gain Score for Variable B			Predicted Gain Score for Variable C			Total Predicted Gain Score		
Group	A	B	C	A	B	C	A	B	C	A	B	C
HHH	10.53	9.53	7.36	4.74	8.41	4.13	6.53	4.61	8.27	21.80	22.55	19.76
HHA	8.50	7.50	5.33	0.68	4.35	0.07	13.48	11.56	15.22	22.67	23.42	20.63
HHL	6.94	5.94	3.77	-2.44	1.23	-3.05	18.84	16.92	20.58	23.34	24.09	21.30
HAH	7.05	6.05	3.88	14.39	18.06	13.78	3.84	1.92	5.58	25.28	26.03	23.24
HAA	5.02	4.02	1.85	10.33	14.00	9.72	10.79	8.87	12.53	26.15	26.90	24.11
HAL	3.46	2.46	0.29	7.21	10.88	6.60	16.15	14.23	17.89	26.82	27.57	24.78
HLH	3.57	2.57	0.40	24.04	27.71	23.43	1.15	-0.77	2.89	28.76	29.51	26.72
HLA	1.54	0.54	-1.63	19.99	23.66	19.38	8.09	6.17	9.83	29.63	30.38	27.59
HLL	-0.02	-1.02	-3.19	16.87	20.54	16.26	13.45	11.53	15.19	30.30	31.05	28.26
AHH	13.81	12.81	10.64	-1.42	2.25	-2.03	0.28	-1.64	2.02	12.66	13.41	10.62
AHA	11.78	10.78	8.61	-5.47	-1.80	-6.08	7.23	5.31	8.97	13.53	14.28	11.49
AHL	10.22	9.22	7.05	-8.60	-4.93	-9.21	12.58	10.66	14.32	14.20	14.95	12.16
AAH	10.33	9.33	7.16	8.23	11.90	7.62	-2.42	-4.34	-0.68	16.14	16.89	14.10
AAA	8.30	7.30	5.13	4.18	7.85	3.57	4.53	2.61	6.27	17.01	17.76	14.97
AAL	6.74	5.74	3.57	1.05	4.72	0.44	9.89	7.97	11.63	17.68	18.43	15.64
ALH	6.85	5.85	3.68	17.89	21.56	17.28	-5.11	-7.03	-3.37	19.62	20.37	17.58
ALA	4.82	3.82	1.65	13.84	17.51	13.23	1.84	-0.08	3.58	20.49	21.24	18.45
ALL	3.26	2.26	0.09	10.71	14.38	10.10	7.19	5.27	8.93	21.16	21.91	19.12
LHH	17.08	16.08	13.91	-7.58	-3.91	-8.19	-5.98	-7.90	-4.24	3.53	4.28	1.49
LHA	15.06	14.06	11.89	-11.63	-7.96	-12.24	0.97	-0.95	2.71	4.40	5.15	2.36
LHL	13.49	12.49	10.32	-14.75	-11.08	-15.36	6.33	4.41	8.07	5.07	5.82	3.03
LAH	13.60	12.60	10.43	2.07	5.74	1.46	-8.67	-10.59	-6.93	7.01	7.76	4.97
LAA	11.58	10.58	8.41	-1.98	1.69	-2.59	-1.72	-3.64	0.02	7.88	8.63	5.84
LAL	10.02	9.02	6.85	-5.10	-1.43	-5.71	3.63	1.71	5.37	8.55	9.30	6.51
LLH	10.12	9.12	6.95	11.73	15.40	11.12	-11.37	-13.29	-9.63	10.49	11.24	8.45
LLA	8.10	7.10	4.93	7.68	11.35	7.07	-4.42	-6.34	-2.68	11.36	12.11	9.32
LLL	6.53	5.53	3.36	4.55	8.22	3.94	0.94	-0.98	2.68	12.03	12.78	9.99

TABLE XX

Predictions of Percentage Gain Based on Given Individual Group Pretest Scores for Tone Groups

Pretest Score Group	Predicted Gain Score for Variable A			Predicted Gain Score for Variable B			Predicted Gain Score for Variable C			Total Predicted Gain Score		
	A	B	C	A	B	C	A	B	C	A	B	C
HHH	0.4625	0.4193	0.3764	0.1625	0.3010	0.1695	0.2339	0.1848	0.2808	0.8589	0.9051	0.8267
HHA	0.3863	0.3431	0.3002	0.0052	0.1437	0.0122	0.3941	0.3450	0.4410	0.7856	0.8318	0.7534
HHL	0.3275	0.2843	0.2414	-0.1161	0.0224	-0.1091	0.5176	0.4685	0.5645	0.7290	0.7752	0.6968
HAH	0.3425	0.2993	0.2564	0.4856	0.6241	0.4926	0.1452	0.0961	0.1921	0.9734	1.0196	0.9412
HAA	0.2663	0.2231	0.1802	0.3284	0.4669	0.3354	0.3054	0.2563	0.3523	0.9000	0.9462	0.8678
HAL	0.2075	0.1643	0.1214	0.2071	0.3456	0.2141	0.4289	0.3798	0.4758	0.8435	0.8897	0.8113
HLH	0.2223	0.1791	0.1362	0.8091	0.9476	0.8161	0.0565	0.0074	0.1034	1.0879	1.1341	1.0557
HLA	0.1461	0.1029	0.0600	0.6518	0.7903	0.6588	0.2167	0.1676	0.2636	1.0146	1.0608	0.9824
HLL	0.0873	0.0441	0.0012	0.5305	0.6690	0.5375	0.3402	0.2911	0.3871	0.9580	1.0042	0.9258
AHH	0.4755	0.4323	0.3894	-0.0619	0.0766	-0.0549	0.0581	0.0090	0.1050	0.4717	0.5179	0.4395
AHA	0.3992	0.3560	0.3131	-0.2192	-0.0807	-0.2122	0.2183	0.1692	0.2652	0.3983	0.4445	0.3661
AHL	0.3404	0.2972	0.2543	-0.3405	-0.2020	-0.3335	0.3418	0.2927	0.3887	0.3418	0.3880	0.3096
AAH	0.3554	0.3122	0.2693	0.2612	0.3997	0.2682	-0.0305	-0.0796	0.0164	0.5861	0.6323	0.5539
AAA	0.2792	0.2360	0.1931	0.1039	0.2424	0.1109	0.1297	0.0806	0.1766	0.5128	0.5590	0.4806
AAL	0.2204	0.1772	0.1343	-0.0173	0.1212	-0.0103	0.2532	0.2041	0.3001	0.4562	0.5024	0.4740
ALH	0.2352	0.1920	0.1491	0.5847	0.7232	0.5917	-0.1192	-0.1683	-0.0723	0.7007	0.7469	0.6685
ALA	0.1590	0.1158	0.0729	0.4274	0.5659	0.4344	0.0409	-0.0082	0.0878	0.6273	0.6735	0.5951
ALL	0.1002	0.0570	0.0141	0.3061	0.4446	0.3131	0.1645	0.1154	0.2114	0.5708	0.6170	0.5386
LHH	0.4884	0.4452	0.4023	-0.2863	-0.1478	-0.2793	-0.1176	-0.1667	-0.0707	0.0844	0.1306	0.0522
LHA	0.4121	0.3689	0.3260	-0.4436	-0.3051	-0.4366	0.0425	-0.0066	0.0894	0.0111	0.0573	-0.0211
LHL	0.3534	0.3102	0.2673	-0.5649	-0.4264	-0.5579	0.1660	0.1169	0.2129	-0.0455	0.0007	-0.0777
LAH	0.3683	0.3251	0.2822	0.0368	0.1753	0.0438	-0.2063	-0.2554	-0.1594	0.1988	0.2450	0.1666
LAA	0.2921	0.2489	0.2060	-0.1205	0.0180	-0.1135	-0.0461	-0.0952	0.0008	0.1255	0.1717	0.0933
LAL	0.2333	0.1903	0.1472	-0.2418	-0.1033	-0.2348	0.0774	0.0283	0.1243	0.0690	0.1152	0.0368
LLH	0.2482	0.2050	0.1621	0.3602	0.4987	0.3672	-0.2950	-0.3441	-0.2481	0.3134	0.3596	0.2812
LLA	0.1719	0.1287	0.0858	0.2029	0.3414	0.2099	-0.1348	-0.1839	-0.0879	0.2400	0.2862	0.2078
LLL	0.1131	0.0699	0.0270	0.0817	0.2202	0.0887	-0.0113	-0.0604	0.0356	0.1835	0.2297	0.1513

an effort to reduce the variability, the percentage gain score was introduced and in Parts II and III both the gain and percentage gain scores have been investigated. This section describes another attempt at forcing more homogeneity in the subjects.

Some of the subjects score quite high on the pretests. This fact insures that their gains are necessarily low and the use of percentage gain helps somewhat but does not seem to take care of these cases too well. In a rather arbitrary manner subjects were deleted if any one of their initial scores was more than one standard deviation above the mean. The resulting group is called the selected group. In the Autumn, the reduction was from 131 to 108, in Winter from 112 to 85, and in Spring from 101 to 80.

The means and standard deviation for the selected group are in Tables XXI-XXV. Tables XXVI, XXVII-XVIIIcontain the Variance-Covariance matrices that are pertinent to the analysis described in Part II. Tables XXX-XXXII contain the regression coefficient similar to Tables XII-XIV.

This analysis did not reveal any differences that were not evident without the group selection, although the gain scores were increased by selection, the variance or standard deviation was not changed appreciably. The percentage gain scores were reduced but so was the variance, so, again, not much was gained by selection. The analysis in Part II and summarized in Table XI shows very little difference between the total group and the selected group. A similar statement applies to the significant regression coefficients in Tables XI-XIV and XXX-XXXII.

Table XXI

Means, Standard Deviations and Correlations for the Initial Scores, the Gain Scores and Percentage Gain Scores for Autumn Duple Rhythm Only

Group		Means A	Means B	Means C	Means Total	Standard Deviations A	Standard Deviations B	Standard Deviations C	Standard Deviations Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
	n	34	38	36	108									
Initial Test	A	9.206	9.316	10.000	9.509	6.275	6.998	6.547	6.575	A-B	.84	.85	.79	.83
	B	13.412	14.342	14.444	14.083	10.790	11.348	10.678	10.860	A-C	.80	.78	.80	.79
	C	17.971	18.026	19.500	18.500	13.438	13.070	13.849	13.342	B-C	.96	.95	.92	.94
Gain	A	39.882	35.158	38.444	37.741	11.428	12.933	13.752	12.805	A-B	.86	.63	.85	.76
	B	34.059	35.684	34.750	34.861	12.331	11.426	13.580	12.362	A-C	.61	.61	.69	.64
	C	32.794	31.132	32.778	32.204	11.541	12.825	14.965	14.965	B-C	.80	.87	.84	.83
<u>Gain</u> 64-pre	A	.741	.650	.717	.701	.221	.236	.246	.236	A-B	.94	.80	.93	.86
	B	.704	.733	.708	.716	.254	.195	.253	.233	A-C	.92	.74	.88	.84
	C	.749	.687	.738	.723	.227	.216	.282	.243	B-C	.91	.86	.90	.88

Table XXII

Means, Standard Deviations and Correlations for the Initial Scores, the Gain Scores and Percentage Gain Scores for Autumn Triple Rhythm Only

Group		Means A	Means B	Means C	Means Total	SD A	SD B	SD C	SD Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
	n	34	38	36	108									
Initial Test	A	8.441	8.447	8.083	8.324	4.956	5.341	6.547	5.289	A-B	.80	.85	.85	.83
	B	12.088	10.658	11.028	11.231	6.658	6.739	10.678	7.029	A-C	.71	.83	.80	.78
	C	15.000	12.684	15.194	14.250	8.367	8.540	13.849	8.817	B-C	.89	.89	.93	.90
Gain	A	17.176	14.842	16.444	16.111	6.240	5.792	8.220	6.832	A-B	.62	.72	.78	.68
	B	13.324	15.658	14.333	14.481	5.978	6.174	7.282	6.517	A-C	.32	.59	.62	.51
	C	13.088	15.026	12.806	13.676	6.837	8.079	9.208	8.108	B-C	.64	.82	.82	.78
Gain / 36-pre	A	.645	.553	.599	.598	.248	.215	.286	.251	A-B	.81	.77	.87	.80
	B	.590	.640	.605	.612	.261	.230	.273	.253	A-C	.77	.62	.73	.70
	C	.669	.652	.599	.640	.264	.261	.369	.301	B-C	.80	.76	.74	.75

Table XXIII

Means, Standard Deviations and Correlations
for the Initial Scores, the Gain Scores
and Percentage Gain Scores for
Atumn Duple and Triple Rhythm Combined

Group	n	Means A 34	Means B 38	Means C 36	Means Total 108	Standard Deviations A	Standard Deviations B	Standard Deviations C	Standard Deviations Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
Initial Test	A	17.647	17.763	18.083	17.833	9.822	10.551	9.250	9.812	A-B	.91	.90	.86	.89
	B	25.500	25.000	25.472	25.315	15.985	16.985	15.055	15.651	A-C	.91	.88	.82	.87
	C	32.971	30.711	34.694	32.750	20.135	19.687	19.647	19.700	B-C	.96	.95	.93	.94
Gain	A	57.059	50.000	54.889	53.852	16.456	16.114	19.473	17.500	A-B	.86	.68	.85	.77
	B	47.382	51.342	49.083	49.343	16.569	15.260	17.560	16.393	A-C	.64	.62	.67	.63
	C	45.882	46.158	45.583	45.880	15.863	17.605	19.840	17.708	B-C	.79	.90	.83	.83
Gain / 100-pre	A	.709	.619	.678	.667	.223	.210	.239	.225	A-B	.94	.82	.92	.87
	B	.670	.702	.678	.684	.250	.192	.241	.226	A-C	.93	.71	.90	.85
	C	.726	.675	.715	.705	.227	.215	.258	.232	B-C	.93	.87	.91	.89

Table XXIV

Means, Standard Deviations and Correlations
for the Initial Scores, the Gain Scores
and Percentage Gain Scores for
Winter Intervals

Group	n	Means A 33	Means B 28	Means C 24	Means Total 85	Standard Deviation A	Standard Deviation B	Standard Deviation C	Standard Deviation Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
Initial Test	A	8.394	7.500	7.667	7.894	3.791	4.476	3.852	4.018	A-B	.70	.75	.77	.73
	B	6.758	6.429	6.792	6.659	3.985	3.646	4.273	3.917	A-C	.39	.57	.77	.56
	C	4.152	3.179	4.417	3.906	2.751	2.510	3.243	2.839	B-C	.64	.69	.78	.70
Gain	A	9.394	5.964	5.500	7.165	3.230	4.256	4.011	4.174	A-B	.27	.51	.40	.36
	B	5.667	6.214	4.833	5.612	3.830	3.542	3.485	3.639	A-C	-.18	.44	.60	.23
	C	2.152	2.429	3.750	2.694	3.346	3.553	4.866	3.907	B-C	.23	.30	.46	.29
Gain / 24-pre	A	.626	.364	.353	.463	.227	.258	.268	.279	A-B	.15	.58	.66	.39
	B	.327	.380	.304	.338	.210	.241	.226	.225	A-C	-.05	.42	.76	.30
	C	.105	.114	.212	.138	.169	.167	.287	.211	B-C	.39	.35	.73	.46

Table XXV

Means, Standard Deviations and Correlations for the Initial Scores, the Gain Scores and Percentage Gain Scores for Spring Tone Groups

Group		Means A	Means B	Means C	Means Total	SD A	SD B	SD C	SD Total	Var. Pair	Correlations A	Correlations B	Correlations C	Correlations Total
	n	30	29	21	80									
Initial Test	A	7.200	8.241	7.714	7.712	4.723	5.468	5.451	5.149	A-B	.66	.88	.78	.78
	B	6.767	7.828	8.000	7.475	4.125	5.562	4.680	4.802	A-C	.28	.81	.57	.55
	C	2.567	3.138	4.762	3.350	2.932	3.248	4.110	3.457	B-C	.30	.67	.71	.57
Gain	A	6.400	6.862	4.286	6.012	6.038	6.022	4.518	5.703	A-B	.51	.74	.69	.63
	B	3.533	8.310	3.286	5.200	4.981	8.384	5.605	6.896	A-C	.49	.28	.46	.37
	C	3.000	2.897	3.857	3.188	4.136	4.039	5.686	4.517	B-C	.32	.06	.50	.21
Gain / 48-pre	A	.163	.181	.117	.157	.157	.167	.138	.156	A-B	.56	.78	.72	.68
	B	.085	.211	.086	.131	.126	.225	.148	.182	A-C	.56	.47	.63	.51
	C	.066	.068	.090	.073	.095	.097	.138	.108	B-C	.39	.21	.55	.31

Table XXVI

Variance-Covariance Matrix for Selected Group for
Autumn Rhythm Study

Variance-Covariance Matrix for Gain Scores

		Variable		
Group	n	A	B	C
A	34	270.7843	235.0071	116.3102
			274.5463	206.8645
				251.6221
B	38	259.6757	166.4865	174.8328
			232.8798	241.7013
				309.9203
C	36	379.1873	289.8667	258.4381
			308.3643	289.8643
				393.6214
Total	108	306.2395	220.0419	195.8044
			268.7320	242.4155
				313.5835

Variance-Covariance Matrix for Percentage Gain

$\left(\frac{\text{Gain}}{\text{100-pre}}\right)$ Scores

A	34	.0495368	.0520911	.0470510
			.0623580	.0524980
				.0513537
B	38	.0441469	.0329606	.0318470
			.0367257	.0357352
				.0460255
C	36	.0569402	.0530426	.0555111
			.0578731	.056234
				.0665983
Total	108	.0505913	.0442912	.0445383
			.0510554	.0467951
				.0540267

Table XXVII

Variance-Covariance Matrix for Selected Group for
Winter Interval Study

Variance-Covariance Matrix for Gain Scores

		Variable		
Group	n	A	B	C
A	33	10.43371	3.385417 14.66667	-1.905303 2.958333 11.19508
B	28	18.10979	7.674603 12.54497	6.608466 3.719577 12.62434
C	24	16.08696	5.565217 12.14493	11.78261 7.826087 23.67391
Total	85	17.42493	5.457563 13.24034	3.753361 4.165546 15.26246

Variance-Covariance Matrix for Percentage Gain

$\left(\frac{\text{Gain}}{100\text{-pre}}\right)$ Scores

A	30	.0513748	.0073522 .0441774	-.0017989 .0139660 .0284008
B	29	.0667110	.0357892 .0579184	.0183681 .0138951 .0278155
C	21	.0716936	.0397340 .0511705	.0579854 .0471883 .0822548
Total	80	.0777477	.0241804 .0504107	.0174106 .0218072 .0444558

Table XXVIII

Variance-Covariance Matrix for Selected Group for
Spring Tone Group Study

Variance-Covariance Matrix for Gain Scores

		Variable		
Group	n	A	B	C
A		36.45517	15.43448	12.31034
			24.80920	6.551724
				17.10345
B		36.26601	37.33005	6.770936
			70.29310	2.068965
				16.31034
C		20.41429	17.36429	11.79286
			31.41429	15.89286
				32.32857
Total		32.51883	24.89620	9.478639
			47.55443	6.607595
				20.40744

Variance-Covariance Matrix for Percentage Gain

$\left(\frac{\text{Gain}}{100-\text{pre}}\right)$ Scores

Group	n			
A		.0246547	.0111122	.0084099
			.0159545	.0047399
				.0091045
B		.0279769	.0292612	.0075297
			.0507899	.0045664
				.0093565
C		.0189913	.0148065	.0118823
			.0219765	.0113179
				.0189738
Total		.0244149	.0192827	.0085225
			.0331255	.0059575
				.0115669

Table XXIX

Composite Variance-Covariance Matrices

Quarter	Vairable	n	A	B	C
Autumn	Gain (Comb)	108	303.2158	230.45343 271.93013	199.86203 246.14337 318.38793
	%Gain (Comb)	108	.0502080	.0460314 .0523189	.0448364 .0483189 .0546592
	Gain (Duple)	108	162.3249	124.3401 155.6749	106.7929 135.5637 169.3587
	%Gain (Duple)	108	.0549731	.0491474 .0554784	.0481458 .0510165 .0593448
	Gain (Triple)	108	46.68261	31.78529 42.29742	29.56973 40.73807 65.60293
	%Gain (Triple)	108	.0630677	.0527309 .0650725	.0537849 .0582271 .0912505
Winter	Gain	85	14.87682	5.54175 13.11886	5.49526 4.83467 15.83111
	%Gain	85	.0632407	.0276251 .0510888	.0248311 .0250165 .0461570
Spring	Gain	80	31.04516	23.37627 42.17220	10.29138 8.17118 21.91412
	%Gain	80	.0238743	.018933 .0295736	.0092740 .0068747 .0124783

Table XXX

Regression Coefficients for Gain Scores on Pre Scores and Groups for Selected Groups for Autumn Rhythm Study

Dependent Variable	Pre			Group			Const.	
	A	B	C	A	B	C		
Duple + Triple								
Gain - A	-.882*	.276	.348	2.796	-3.154	0.357	50.127	16.692
B	.038	-.739*	.485*	-1.837	2.846	-1.010	49.369	16.240
C	.038	.169	-.530*	0.080	-0.763	+0.683	58.313	16.358
Duple								
A	-.8534*	.0973	.3868	2.065	-2.677	.612	37.418	12.382
B	.1639	-1.0386*	.5469*	-1.1134	1.4298	-.3164	37.764	11.815
C	.1520	.0634	-.5898	.335	-1.370	-1.035	40.808	11.438
Triple								
A	-.9483*	.4292*	.2086	.6294	-.6021	-.0273	16.234	6.291
B	-.2131	-.4438*	.2438	-.893	1.372	-.479	17.724	6.146
C	-.0723	.3926	-.7749*	-.3213	.3841	-.0628	20.898	6.679
Duple + Triple								
% Gain A	-.002871	.003047	.004295	.03847	-.03971	.00114	.48167	.1921
B	-.000576	.000228	.006170*	-.01486	.03170	-.01684	.48565	.1958
C	-.000746	.002611	.002224	.01966	-.02476	.00510	.57986	.2235
Duple								
A	-.003003	.001604	.006931	.042627	-.050934	.008307	.57763	.2170
B	.003087	.006714	.01091*	-.008851	.025465	-.016614	.57851	.2167
C	.003792	-.002792	.004658	.026544	-.034069	.007525	.6416	.2404
Triple								
A	-.01[illegible]274	.016741*	.006320	.028936	-.024570	-.004366	.41430	.2204
B	-.009043	.010020	.008794	-.03514	.4989	-.01466	.44814	.2337
C	-.006830	.025893*	-.01224	.01675	.00899	-.02574	.58020	.2965

Table XXXI

Regression Coefficients for Gain Scores on Pre Scores and Groups for Selected Groups for Winter Interval Study

Dependent Variable	Pre			Group			Const.	
	A	B	C	A	B	C		
Gain - A	-.509*	.278*	.230	2.635	-0.935	-1.700*	8.198	3.601
B	.120	-.455*	.545*	-0.054	0.982	-0.929*	5.524	3.493
C	.047	.452	-.497	-0.578	-0.593	1.171*	1.341	3.714
% Gain A	-.004170	.018613*	.015143	.17499	- .06968	- .10531*	.29748	.2340
B	.005293	-.002330	.030197*	-.01956	.06628	- .04673*	.19274	.2093
C	.003104	.022678*	-.015943	-.03906	- .03460	+ .07367*	.03067	.1979

Table XXXII

Regression Coefficients for Gain Scores on Pre Scores and Groups for Selected Groups for Spring Tone Groups Study

Dependent Variable		Pre			Group			
		A	B	C	A	B	C	Const.
Gain	A	-.249	.304	.770*	1.363	1.323	-2.687*	2.801	5.002
	B	.503*	-.849*	1.058*	-0.922	3.627	-2.705*	3.860	5.544
	C	.520*	.118	-.386*	-0.248	-0.797	1.045*	-0.301	3.802
% Gain	A	.000543	.006918	.018961*	.03202	.03165	- .06367*	.03123	.1304
	B	.013478*	-.018119*	.02704*	-.02397	.09173	- .06775*	.06452	.1463
	C	.012327*	.002521	-.006866*	-.00634	-.01668	+ .02301*	-.01548	.0899

DISCUSSION AND SUMMARY

The research undertaken was to determine from further analysis of past research, individual student error patterns, in order to develop work scores and classify these by method and individual characteristics. A further objective of the research was, if possible, to establish a system for diagnosing students' basic music learning ailments and predict from an existing spectrum of differential auto-instructional methods the needed treatment for a given set of individual characteristics. Finally, the research was an experiment with a group of students so that an evaluation of this clinical type instructional program could be made.

A coding system was evolved to undertake the item analysis and subsequent use of individual student error patterns and work scores. The variance in error patterns was not as great as first believed. Even though item analyses of student work offers considerable information, there was no way in which the data could be used to assist in pairing information of student work with different methods of instruction.

A surprising outcome of the initial attempt to diagnose student characteristics from standard test scores used in the School of Music was the lack of relationship of individual characteristics to the training. This is especially noteworthy since analyses of previous research had indicated usable relationships. The lack of relationship of background test scores indicates that such measurements are not critical to the specific learning tasks. It was, therefore, decided to ignore those measurements in placement and subsequent analysis. Instead, a more effective means of placing students in the individual training was on the basis of known pre scores on the training to be undertaken. Even though the data indicate that it is not extremely accurate to predict an individual score on this basis, it is important to note that there are types of individuals who as a group respond to particular types of treatment.

From the research it was possible to distinguish individuals and groups as a particular type of learning problem, which could be dealt with on an individual-group basis, with the predicted gain scores established.

It is evident, from this research, that there is a need to pursue the individuality of students to determine their needs for specialized grouping and treatment for better learning. It appears important to pursue learning problems more from an operational procedure rather than from a background analytical analysis. It appears that what a student is when combined with an appropriate learning environment and motivation is more important than what the student was before a particular learning task was begun. There certainly are a variety of ways in which this problem can be investigated. This research, even though highly controlled, could be classified as a very small step toward larger, more sophisticated research involving computerized instruction, individual counselling and more refined methodology.

It is indeed important to realize, and this research further points out the realization, that individuals must receive specialized attention and instruction to attain the greatest benefit from an instructional or learning environment. It cannot be assumed that every individual receives the same benefit from the same instruction. The elements of individual variability and motivation make even a highly organized instructional environment different for different people. The need is to provide as much flexibility in the system utilizing modern technology and new media in order to enhance the multiple presentations of information to a variety of individuals. The teacher and student should be aware of as many possibilities as are available to meet the challenge of improved learning.

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APPENDIX A

THE ANALYSIS OF THE DIFFERENTIAL EFFECTS OF SIX EXPERIMENTAL TREATMENTS FOR THREE BASIC MUSIC ELEMENTS INVESTIGATED IN THE FIRST PHASE OF A GRANT SUPPORTED BY THE U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, OFFICE OF EDUCATION UNDER TITLE VII 85-864 GRANT NUMBER 7-45-0430-214, A COMPARISON BETWEEN DIFFERENT STIMULI COMBINED WITH TWO METHODS FOR PROVIDING KNOWLEDGE OF RESULTS IN MUSIC INSTRUCTION

SUPPORTING DATA FROM PHASE I, OFFICE OF EDUCATION GRANT

NUMBER 7-45-0430-214 WHICH RELATES TO THIS RESEARCH

In Tables I, II, and III the following can be observed:

(1) part number 1 in each Table, there was a significant improvement in the scores of all of the subjects. These pretest and posttest mean scores are shown in number 6;

(2) part number 2, other factors (individuals differences) were significant at the 1 per cent level;

(3) part number 3 and part number 7, there were significant differential effects for the experimental groups of the various auto-instructional music methods.

It is important to know, however, that if all students would have achieved optimal learning the posttest means under number 7 would read:

Table I 182

Table II 72

Table III 108.

Table I

Total Scores Phase I, OE Grant Number 7-45-0430-214
Ohio State Research Foundation Number 1677
Basic Music Element, Rhythm
Number of Subjects = 95
(F Significant at the 5 per cent level indicated by *, 1 per cent by **)

Source	Sum of Squares	Degrees of Freedom	Mean Square	F
1. Grand Mean of Posttest-Pretest Differences	945,405.57	1	945,405.57	915.56**
2. Fall Quarter Fundamentals of Music Section	3,832.73	3	1,277.58	1.24
Other Factors	95,971.33	16	5,998.21	5.81**
3. Treatment of Fall Quarter Experimental Groups				
a. (Column)	1,225.95	1	1,225.95	1.19
b. (Row)	1,486.99	2	743.50	.72
c. Interaction	158.54	2	79.27	.08
4. Residuals	72,281.89	70	1,032.60	
5. Total	1,120,363.00	95		

6. Means and Differences between Means

Fall Quarter Treatment Group	1	2	3	4	5	6	Total
Number of Students	16	17	17	15	15	15	95
Pretest Mean	48.9	58.5	74.7	43.1	44.5	52.8	54.2
Posttest Mean	154.3	142.3	159.8	160.0	154.8	153.5	154.0
Differences	105.4	83.8	85.1	116.9	110.3	100.7	99.8

7. Differences between Groups due to Experimental Treatment

Treatment Group	2	3	5	6	1	4
Number of Students	17	17	15	15	16	15
Adjusted Mean	0.0	6.6	11.7	12.9	13.7	18.9

Adjusted means not underlined or connected by the same line are significantly different at the 5 per cent level.

Table II

Total Scores Phase I, OE Grant Number 7-45-0430-214
Ohio State Research Foundation Number 1677
Basic Music Element, Intervals
Number of Subjects = 83
(F Significant at the 5 per cent level indicated by *, 1 per cent by **)

	Source	Sum of Squares	Degrees of Freedom	Mean Square	F
1.	Grand Mean of Posttest-Pretest Differences	50,533.78	1	50,533.78	427.2[illegible]**
2.	Fall Quarter Experimental Treatment	81.26	5	16.25	.14
	Winter Quarter Fundamentals of Music Section	426.78	3	142.26	1.20
	Other Factors	5,272.65	19	277.51	2.35**
3.	Treatment of Winter Quarter Experimental Groups				
	a. (Column)	52.[illegible]	1	52.12	.44
	b. (Row)	1,042.69	2	521.34	4.41*
	c. Interaction	114.07	2	57.04	.48
4.	Residuals	5,914.65	50	118.29	
5.	Total	63,438.00	83		

6. Means and Differences between Means of Test Scores

Winter Quarter Treatment Group	1	2	3	4	5	6	Total
Number of Students	15	14	13	14	14	13	83
Pretest Mean	41.8	45.2	34.8	39.3	40.7	29.7	38.8
Posttest Mean	69.5	61.6	61.7	68.5	60.7	57.6	63.5
Difference	27.7	16.4	26.9	29.2	20.0	27.9	24.7

7. Differences between Means due to Experimental Treatment of Winter Quarter Groups

Treatment Group	2	5	3	6	4	1
Number of Students	14	14	13	13	14	15
Adjusted Mean	0.0	4.9	10.5	12.2	12.3	13.7

Adjusted means not underlined or connected by the same line are significantly different at the 5 per cent level.

Table III

Total Scores Phase I, OE Grant Number 7-45-0430-214
Ohio State Research Foundation Number 1677
Basic Music Element, Tone Group
Number of Subjects = 69
(F Significant at the 5 per cent level indicated by *, 1 per cent by **)

Source	Sum of Squares	Degrees of Freedom	Mean Square	F
1. Grand Mean of Posttest-Pretest Differences	41,441.75	1	41,441.75	121.07**
2. Fall Quarter Rhythm Scores	188.30	2	94.15	.28
Winter Quarter Interval Scores	4,107.39	4	1,026.85	3.00*
Spring Quarter Fundamentals of Music Section	4,309.13	3	1,436.38	4.20*
Other Factors	19,449.71	19	1,023.67	2.99**
3. Treatment of Spring Quarter Experimental Groups				
a. (Column)	331.80	1	331.80	.97
b. (Row)	2,990.84	2	1,495.42	4.37*
c. Interaction	31.58	2	15.79	.05
4. Residuals	11,980.50	35	342.30	
5. Total	84,831.00	69		

6. Means and Differences between Means of Test Scores

Spring Quarter Treatment Group	1	2	3	4	5	6	Total
Number of Students	11	12	11	11	12	12	69
Pretest Mean	17.9	29.0	21.9	42.6	17.2	25.1	25.5
Posttest Mean	42.7	46.5	43.0	72.2	47.7	48.9	50.0
Difference	24.8	17.5	21.1	29.6	30.5	23.8	24.5

7. Difference between Means due to Experimental Treatment of Spring Quarter Groups

Treatment Group	3	6	2	5	1	4
Number of Students	11	12	12	12	11	11
Adjusted Means	0.0	7.9	12.6	16.4	24.4	30.4

Adjusted means not underlined or connected by the same line are significantly different at the 5 per cent level.

APPENDIX B

ITEM ANALYSIS CODE AND PROCEDURES

For each type of training, it was desirable to know the most common sources of error and the most common erroneous responses. Therefore, the first exercise attempted by each student for each level of difficulty was examined in order that errors might be tabulated.

Rhythm Item Analysis Code

For analysis of rhythm errors, a code was devised by which numbers were assigned for: (1) each one-beat rhythmic pattern; (2) to indicate that no answer was attempted, and (3) to indicate a "nonsense" response (a nonsense response was designated as one other than the rhythms used).

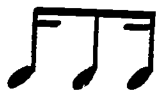
Duple Rhythm Code

1 = 

2 = 

3 = 

4 = 

5 = 

6 = 

7 = 

8 = 

9 = no response

10 = nonsense

Triple Rhythm Code

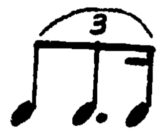
1 = 

2 = 

3 = 

4 = 

5 = 

6 = 

9 = no response

10 = nonsense

RHYTHM - ITE . ANALYSIS

STUDENT NUMBER____________ CLASS____________ Tapes: 20, 40, 60, 80, 100

NAME____________ MODE OF TRAINING____________ YEAR________

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	111	121	131	141	151	161	211	311	411	511	611	221	331	441	551	661
20	40						40					80				
80	60	60					60									

20 (24)	40 (24)	60 (22)	80 (24)	100 (20)

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
231	241	251	261	321	341	351	361	421	431	451	461	521	531	541	561	621	631	641	651

Item analysis sheets were used in which a vertical column was provided for each 3-beat rhythm; and a horizontal space was provided for each appearance of this rhythm in each exercise. For each student response there was an appropriate space in which to code the student's response. Th information was further compiled with one master analysis sheet.

Interval Item Analysis Code

Interval item analysis sheets were prepared on which could be recorded, for each student, how often an interval had been incorrectly identified in each exercise in which it appeared. The following code was used:

Interval Code	Interval Code
Perfect Prime - PP	Perfect fifth - P5
Minor second - -2	Minor sixth - -6
Major second - +2	Major sixth - +6
Minor third - -3	Minor seventh - -7
Major third - +3	Major seventh - +7
Perfect fourth - P4	Perfect octave - P*
Tritone - T	

Tone Group Item Analysis Code

Each tone group involves two intervals and one of four rhythm patterns. It was possible to use the same code number for each rhythm previously used during the rhythm portion of the study.

STUDENT NUMBER ________ CLASS ________ YEAR ________

STUDENT NAME ________ METHOD OF TRAINING ________ EXERCISE ________

Answer	m2	M2	m3	M3	P4	T	[illegible]	m6	M6	m7	M7	P8
Item												
m2												
M2												
m3												
M3												
P4												
T												
P5												
m6												
M6												
m7												
M7												
P8												
Nonsense												
No answer												

ITEM ANALYSIS - TONE GROUPS

STUDENT NUMBER________________ CLASS____________ TAPES: TGB 10, 30, 50, 60

NAME________________ MODE____________ YEAR: ____________

	-2	+2	+2	-2	+2	+2	-3	P4	+3	-3	P4	+3
10												
30												
50 2												
4												
5												
6												
60 2												
4												
5												
6												

ITEM ANALYSIS - TONE GROUPS

STUDENT NUMBER____________ CLASS____________ TAPES: TuB 20, 40, 70, 80

NAME____________ MODE____________ YEAR: ____________

	+2	+3	-3	+3	+3	P4	+3	T	P4	-3	T	+2
20												
40												
70 2												
4												
5												
6												
80 2												
4												
5												
6												

ITEM ANALYSIS - TONE GROUPS

STUDENT NUMBER________________ CLASS________________. TAPES: TGC 10, 30, 50, 60

NAME________________ MODE________________ YEAR: ________________

	-2	+2	+2	-2	+2	+2	-3	+3	+3	P4	P4	-3
10												
30												
50 2												
4												
5												
6												
60 2												
4												
5												
6												

ITEM ANALYSIS - TONE GROUPS

STUDENT NUMBER________________ CLASS____________ TAPES: TGC 20, 40, 70, 80

NAME________________ MODE____________ YEAR: ____________

	+2	T	-3	P4	+3	+2	+3	-3	P4	+3	T	+3
20												
40												
70 2												
4												
5												
6												
80 2												
4												
5												
6												

ITEM ANALYSIS - TONE GROUPS

STUDENT NUMBER____________________ CLASS____________________ TAPES: TGD 10, 30, 50, 60

STUDENT NAME____________________ MODE____________________ YEAR: ____________________

	-2	-7	+2	-7	+2	+7	-3	P5	+3	+6	P4	-6
10												
30												
50 2												
4												
5												
6												
60 2												
4												
5												
6												

ITEM ANALYSIS - TONE GROUPS

STUDENT NUMBER______________ CLASS______________ TAPES: TGD 20, 40, 70, 80

NAME______________ MODE______________ YEAR: ______________

	+2	-6	-3	-6	+3	T	+3	P5	P4	+6	T	-7
20												
40												
70 2												
4												
5												
6												
80 2												
4												
5												
6												

Triple Code Number 2 = 

Duple Code Number 4 = 

No Response = 9

Duple Code Number 5 = 

Duple Code Number 6 = 

Nonsense = 0

The same interval abbreviations were employed as shown in the interval study. Item analysis sheets were prepared in which a vertical double-column was provided for each combination of two intervals used in the exercises. For the exercises in the first half of the training, a horizontal space was provided for each appearance of this combination in each exercise. For exercises in the second half of the training, a horizontal space was provided for the one appearance of this combination with each of the four possible rhythms in each exercise. For each item and response, there was an appropriate space for that particular combination of intervals and rhythm pattern.

The information was further compiled with one chart for each mode of training indicating frequency and types of errors.

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